

NOMENCLATURAL HISTORY AND TAXONOMIC STATUS OF *ECHINACEA ANGUSTIFOLIA*, *E. PALLIDA*, AND *E. TENNESSEENSIS* (ASTERACEAE)

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ABSTRACT

A problem exists in the literature concerning the application of correct names to *Echinacea angustifolia* DC., *E. pallida* (Nutt.) Nutt., and *E. tennesseensis* (Beadle) Small. We review and clarify the past confusion concerning the nomenclatural history of these three taxa from 1753 to 1991. The contrasting views of A. Cronquist and R.L. McGregor on the taxonomic status of *E. angustifolia*, *E. pallida*, and *E. tennesseensis* are briefly discussed. Based on various types of evidence, these three taxa should be recognized as distinct species; thus, McGregor's view is accepted.

RESUMEN

Existe un problema en la bibliografía respecto a la aplicación de los nombres correctos a *Echinacea angustifolia* DC., *E. pallida* (Nutt.) Nutt., y *E. tennesseensis* (Beadle) Small. Se revisa y clarifica la confusión pasada relativa a la historia nomenclatural de estos tres taxa desde 1753 a 1991. Los diferentes puntos de vista de A. Cronquist y R.L. McGregor sobre el estatus taxonómico de *E. angustifolia*, *E. pallida*, y *E. tennesseensis* se discuten brevemente. En base a evidencias de varios tipos, estos tres taxa deben ser reconocidos como especies distintas. Así pues, se acepta el punto de vista de McGregor.

INTRODUCTION

In a recent study of the comparative ecology of the three closely-related species, *Echinacea angustifolia* DC., *E. pallida* (Nutt.) Nutt., and *E. tennesseensis* (Beadle) Small (Snyder 1991), we encountered considerable confusion in the literature concerning the application of the correct names to these three species. For example, several Latin names have been applied to each of these taxa, including the same name to different taxa and different names to the same taxon. Thus, it was evident that a knowledge of the nomenclatural history of these species, whose geographical distribution is well documented (McGregor 1968c), was required to accurately interpret the literature. The purpose here is to (1) present a summary of the history of the nomenclature of *E. angustifolia*, *E. pallida*, and *E. tennesseensis*, and (2) compare the views of A. Cronquist and R.L. McGregor on the taxonomic status of the three taxa.

NOMENCLATURAL HISTORY

A summary of the nomenclatural history of the three *Echinacea* taxa from 1753 to 1991 is presented in Table 1. The material in the table for which references are

TABLE 1. Summary of the nomenclatural history of *Echinacea angustifolia*, *E. pallida*, and *E. tenesseeensis*.

1753	Linnaeus described <i>Rudbeckia purpurea</i> → <i>Rudbeckia purpurea</i> L., the type species of the genus <i>Echinacea</i> .
1790	Necker described the genus <i>Brauneria</i> (no species mentioned) → <i>Brauneria</i> Necker.
1794	Moench described the genus <i>Echinacea</i> based on Linnaeus' <i>Rudbeckia purpurea</i> → <i>Echinacea</i> Moench.
1834	T. Nuttall (1834) described <i>Rudbeckia pallida</i> → <i>Rudbeckia pallida</i> Nutt.
1836	A. DeCandolle described four species of <i>Echinacea</i> , one of which was <i>E. angustifolia</i> → <i>Echinacea angustifolia</i> DC.
1841	T. Nuttall (1841) transferred <i>Rudbeckia pallida</i> Nutt. to <i>Echinacea</i> → <i>Echinacea pallida</i> (Nutt.) Nutt., and also placed <i>Echinacea angustifolia</i> DC. in synonymy with <i>E. pallida</i> , often written as <i>Echinacea pallida</i> Nutt. (e.g., Small 1933; Fernald 1950; Cronquist 1952, 1955; Gleason and Cronquist 1963, 1991; Steyermark 1963; Hartley 1966; Radford et al. 1968; Barker 1969; Hitchcock and Cronquist 1973; Swink and Wilhelm 1979; Mohlenbrock 1986).
1841	T. Nuttall (1841) described <i>Echinacea sanguinea</i> → <i>Echinacea sanguinea</i> Nutt.
1841–94	Thinking that <i>E. angustifolia</i> DC. and <i>E. pallida</i> (Nutt.) Nutt. were synonyms, authors of many floristic works published during this period used the name <i>E. angustifolia</i> for <i>E. pallida</i> [e.g., Torrey and Gray 1842; Darby 1857; Woods 1872; Brendel 1887; Chapman 1887; Watson and Coulter 1889; also eds. 2–5 of Gray's manual (1856–1867)].
1894	Britton (1894) made the combination <i>Brauneria pallida</i> (Nutt.) Britton, which included <i>Rudbeckia pallida</i> Nutt. [= <i>Echinacea pallida</i> (Nutt.) Nutt.] and <i>E. angustifolia</i> DC. as synonyms.
1898	Britton and Brown (1898) included <i>Rudbeckia pallida</i> Nutt. [= <i>E. pallida</i> (Nutt.) Nutt.] and <i>E. angustifolia</i> under the name <i>Brauneria pallida</i> (Nutt.) Britton.
1898	Thinking that the long-rayed <i>E. pallida</i> (Nutt.) Nutt. was <i>E. angustifolia</i> DC., and unfamiliar with the true <i>E. angustifolia</i> DC. (Fernald 1900), Beadle (1898) described <i>Brauneria tenesseeensis</i> → <i>Brauneria tenesseeensis</i> Beadle, which previously had been included in <i>E. angustifolia</i> DC. (e.g., Gattinger 1887). One wonders if Beadle would have described <i>E. tenesseeensis</i> if Britton (1894) had not made the nomenclatural blunder (cf. Fernald 1900).
1900	Fernald (1900) recognized that <i>E. pallida</i> and <i>E. angustifolia</i> were different species, placed <i>E. sanguinea</i> Nutt. in synonymy with <i>E. pallida</i> , and <i>Brauneria tenesseeensis</i> Beadle in synonymy with <i>E. angustifolia</i> DC.
1900	Heller described <i>Brauneria angustifolia</i> from Texas, the description of which matched (and is a synonym of) <i>E. angustifolia</i> DC. → <i>Brauneria angustifolia</i> Heller, which often has been designated as <i>Brauneria angustifolia</i> (DC.) Heller (e.g., Britton 1901; Rydberg 1906; Robinson and Fernald 1908; Shimek 1911; Blake 1928; Stevens 1950).
1901	Britton (1901) recognized that he had included the names of two distinct taxa under <i>Brauneria pallida</i> (Britton 1894; Britton and Brown 1898), and thus used the names <i>Brauneria pallida</i> (Nutt.) Britton and <i>B. angustifolia</i> (DC.) Heller to refer to these taxa. These names continued to be used in editions 2 and 3 of Britton's manual (Britton 1905, 1907).
1901	Gattinger (1901), apparently following Britton and Brown (1898), used the name <i>Brauneria pallida</i> (Nutt.) Britton for <i>Brauneria tenesseeensis</i> Beadle, which previous to Beadle's (1898) description of this new species had been assumed to be the true <i>Echinacea</i> (<i>Brauneria</i>) <i>angustifolia</i> DC. of the western prairies and plains (e.g., Gattinger 1887).
1903	Small (1903) recognized <i>Brauneria pallida</i> (Nutt.) Britton, <i>B. angustifolia</i> (DC.) Heller, and <i>B. tenesseeensis</i> Beadle as distinct species.
1908	In the seventh edition of Gray's Manual, Robinson and Fernald (1908) recognized that <i>E. pallida</i> was a separate species from <i>Echinacea</i> (<i>Brauneria</i>) <i>angustifolia</i> → <i>Brauneria angustifolia</i> (DC.) Heller (including Tennessee material, i.e., <i>B. tenesseeensis</i>) and <i>B. pallida</i> (Nutt.) Britton.
1913	Britton and Brown (1913) recognized <i>Echinacea pallida</i> (Nutt.) Britton and <i>E. angustifolia</i> DC. as separate species.
1913	Small (1913) again recognized <i>Brauneria pallida</i> (Nutt.) Britton, <i>B. angustifolia</i> (DC.) Heller, and <i>B. tenesseeensis</i> Beadle as distinct species.
1929	Blake (1929) accepted <i>Echinacea</i> rather than <i>Brauneria</i> , and made <i>Brauneria tenesseeensis</i> Beadle a variety of <i>E. angustifolia</i> DC. → <i>E. angustifolia</i> DC. var. <i>tenesseeensis</i> (Beadle) Blake.

TABLE 1. continued

1930	Johns (1930) recognized <i>Brauneria pallida</i> (Nutt.) Britton and <i>Brauneria angustifolia</i> (DC.) Heller as separate taxa.
1932	Rydberg (1932) recognized <i>Echinacea pallida</i> (Nutt.) Britton and <i>E. angustifolia</i> DC. as distinct species.
1933	Small (1933) made the combination <i>Echinacea tennesseensis</i> (Beadle) Small based on <i>Brauneria tennesseensis</i> Beadle.
1942	Steyermark (1942) described <i>Echinacea pallida</i> Nutt. forma <i>albida</i> Steyermark, which McGregor (1968c) put in synonymy with <i>E. pallida</i> (Nutt.) Nutt. However, this white form may have been described from plants of <i>E. simulata</i> McGregor. McGregor (1968c) has dots for <i>E. simulata</i> , but not for <i>E. pallida</i> , in the counties in southeastern Missouri where Steyermark (1963) has symbols for forma <i>albida</i> . According to R.L. McGregor (personal communication), "... white-rayed forms are found in <i>E. angustifolia</i> , <i>E. pallida</i> , <i>E. simulata</i> , and <i>E. purpurea</i> ." We have seen a white-rayed form of <i>E. simulata</i> in Trigg County in western Kentucky and of <i>E. tennesseensis</i> in Wilson County, Tennessee.
1950	In the eighth edition of Gray's manual, Fernald (1950) used the names <i>Echinacea angustifolia</i> DC. and <i>E. pallida</i> Nutt. The range given for <i>E. angustifolia</i> does not include Tennessee, and no mention is made of <i>E. tennesseensis</i> .
1952	Cronquist (1952) did not list <i>E. angustifolia</i> separately, presumably because he did not think that the taxon occurred within the Britton and Brown manual range (R.L. McGregor, personal communication). However, under <i>E. atrorubens</i> Nutt., he made the comment "Similar to <i>E. angustifolia</i> ."
1955	A. Cronquist (1955) reduced <i>E. angustifolia</i> to a variety of <i>E. pallida</i> → <i>E. pallida</i> (Nutt.) Nutt. var. <i>angustifolia</i> (DC.) Cronq. Hitchcock and Cronquist (1973), Cronquist (1980), and Gleason and Cronquist (1991) maintained this classification.
1958	On page 550 in the appendix of the second (1958) and subsequent printings of <i>The New Britton and Brown Illustrated Flora</i> , Cronquist (1958) stated that, "The Great Plains phase of <i>E. pallida</i> ... may be recognized as var. <i>angustifolia</i> (DC.) Cron..."
1959	The question on <i>Echinacea</i> vs. <i>Brauneria</i> was settled at the ninth International Botanical Congress in Montreal, when Necker's 1790 name <i>Brauneria</i> was considered illegitimate. As <i>Echinacea</i> was the first validly published name, it took priority over <i>Brauneria</i> and became the genus name.
1961	W. J. Dress (1961) maintained <i>E. angustifolia</i> and <i>E. pallida</i> as separate species. However, he did not recognize <i>E. tennesseensis</i> , as he stated that "... it [<i>E. angustifolia</i>] also occurs in Tennessee.
1963	In the appendix added to the third printing of <i>Handbook of North Dakota Plants</i> (Stevens 1963), <i>Brauneria angustifolia</i> (DC.) Heller is changed to <i>Echinacea angustifolia</i> DC.
1968	McGregor (1968a) described <i>Echinacea speciosa</i> McGregor. This name was applied to plants of <i>E. pallida</i> (Nutt.) Nutt. in northcentral AR, southeast MO, southern IL, and westcentral KY with yellow pollen and $n = 11$, in contrast to <i>E. pallida</i> (Nutt.) Nutt. which has white pollen and $n = 22$. However, since the binomial <i>E. speciosa</i> already had been used [synonym of <i>Echinacea purpurea</i> (L.) Moench], McGregor (1968b) used the specific epithet <i>simulata</i> to describe the new species → <i>E. simulata</i> McGregor. According to Smith (1978, 1988), it is difficult to determine pollen color in herbarium specimens, and thus fresh pollen is needed to distinguish these two species in the field, since otherwise they are difficult to separate taxonomically (Smith 1973).
1968	McGregor (1968a) described a new variety of <i>E. angustifolia</i> DC. → <i>E. angustifolia</i> DC. var. <i>strigosa</i> McGregor; typical variety becoming <i>E. angustifolia</i> DC. var. <i>angustifolia</i> .
1970	McGregor's (1970) treatment of <i>Echinacea</i> species in the Texas flora is sensu McGregor 1968c.
1980	A. Cronquist (1980) did not recognize <i>E. simulata</i> McGregor as a distinct taxon from <i>E. pallida</i> (Nutt.) Nutt. var. <i>pallida</i> , or <i>E. angustifolia</i> var. <i>strigosa</i> as a distinct taxon from <i>E. pallida</i> var. <i>angustifolia</i> ; suggested that <i>E. sanguinea</i> Nutt. should be treated as a variety of <i>E. pallida</i> ; and considered <i>E. tennesseensis</i> (Beadle) Blake "an eastern outlier" of <i>E. pallida</i> (Nutt.) Nutt. var. <i>angustifolia</i> (DC.) Cronq.
1981	In a letter (dated 27 February 1981) to J. M. Baskin, R.L. McGregor states, "I know <i>angustifolia</i> quite well and based on my observations I just cannot merge the two [<i>E. angustifolia</i> and <i>E. tennesseensis</i>] together as Cronquist insists must be done."

TABLE 1. continued

1986	McGregor's (1986) treatment of <i>Echinacea</i> species of the Great Plains is sensu McGregor 1986c.
1987–90	Bauer and associates demonstrated that <i>E. angustifolia</i> and <i>E. pallida</i> can be distinguished by differences in the chemical constituents in the roots (Bauer and Wagner 1987; Bauer et al., 1988; Bauer and Remiger 1989), but that the alkamides and caffeic acid derivatives in <i>E. angustifolia</i> and <i>E. tennesseensis</i> "... appear to be very similar" (Bauer et al. 1990).
1989	Gandhi and Thomas (1989) reduced <i>E. sanguinea</i> to a variety of <i>E. pallida</i> → <i>E. pallida</i> (Nutt.) Nutt. var. <i>sanguinea</i> (Nutt.) Gandhi & Thomas.
1990	Hatch <i>et al.</i> (1990) used the combination <i>Echinacea pallida</i> (Nutt.) Nutt. var. <i>strigosa</i> (R.L. McGreg.) Gandhi, based on <i>E. angustifolia</i> DC. var. <i>strigosa</i> R.L. McGregor.
1991	Cronquist (Gleason and Cronquist 1991) continued to recognize <i>angustifolia</i> as a variety of <i>E. pallida</i> , and suggested that <i>E. simulata</i> perhaps should be recognized as another variety of <i>pallida</i> . He states that, "An eastern outlier of var. <i>angustifolia</i> , in the cedar glades of c. Tenn., has been called <i>E. tennesseensis</i> ."
1993	In a comparative study of the population genetics of <i>E. angustifolia</i> var. <i>angustifolia</i> and <i>E. tennesseensis</i> , Baskauf (1993) concluded that, " <i>E. tennesseensis</i> and <i>E. angustifolia</i> are genetically distinct taxa."

not cited was taken from Fernald (1900), Sharp (1935), Dress (1961), McGregor (1968c) and/or Foster (1984).

VIEWS OF CRONQUIST AND MCGREGOR

Authors of recent systematic works that include one or more of the three *Echinacea* species are divided between those who follow the taxonomic views of Cronquist (1955, 1980) – e.g., Scoggan (1979), Gandhi and Thomas (1989), and those who follow McGregor (1968c) – e.g., Van Bruggen (1976), Mohlenbrock (1986), Dorn (1988), Yatskievych and Turner (1990), and Taylor and Taylor (1991). A comparison of the views of McGregor and Cronquist on the taxonomic status of *E. angustifolia*, *E. pallida*, and *E. tennesseensis* is presented in Table 2. Whereas Cronquist recognizes one species, *E. pallida*, with three varieties, McGregor recognizes five species and one additional variety, *E. angustifolia* var. *strigosa*. Thus, Cronquist does not recognize either *E. simulata* (But see next to the last item in Table 1.), *E. angustifolia* var. *strigosa*, or *E. tennesseensis* as distinct taxa.

The demonstration of chemical differences in the roots of *E. angustifolia* and *E. pallida* by Bauer and associates (cited in Table 1) lend support to McGregor's (1968c) view that these two taxa are distinct species. And although no differences were detected in the root chemistry of *E. angustifolia* and *E. tennesseensis* (Bauer et al. 1990), Baskauf (1993) convincingly demonstrated by use of allozyme electrophoresis that these two entities are genetically distinct taxa. Intraspecific genetic identities differed significantly from interspecific identity (Baskauf 1993). We conclude that *E. angustifolia*, *E. pallida*, and *E. tennesseensis* should be recognized as distinct species (sensu McGregor 1968c), based on a combination of differences found in comparative studies on the morphology, anatomy, chromosome number, geographical distribution (McGregor 1968c), root chemistry (Bauer and associates, see Table 1), and genetics (Baskauf 1993).

TABLE 2. The two current views on the taxonomic status of *Echinacea angustifolia*, *E. pallida*, and *E. tennesseensis*.

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1. A. Cronquist (1955, 1980)
Echinacea pallida (Nutt.) Nutt. var. *pallida*
E. simulata McGregor (But see next to last item in Table 1.)
E. pallida (Nutt.) Nutt. var. *angustifolia* (DC.) Cronq.
E. angustifolia DC. var. *angustifolia*
E. angustifolia DC. var. *strigosa* McGregor
E. tennesseensis (Beadle) Small - "...an eastern outlier of var. *angustifolia* in the cedar barrens of c Tenn..." (Cronquist 1980) (Also see next to last item in Table 1.)
E. pallida (Nutt) Nutt. var. *sanguinea* (Nutt.) Gandhi and Thomas [Varietal status of *E. sanguinea* was suggested by Cronquist (1980), and formal combination made by K. Gandhi and R. D. Thomas (1989).]
2. R.L. McGregor (1968a)
Echinacea pallida (Nutt.) Nutt.
E. simulata McGregor
E. sanguinea Nutt.
E. angustifolia DC. var. *angustifolia*
E. angustifolia DC. var. *strigosa* McGregor
E. tennesseensis (Beadle) Small
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